At present, no one can accurately predict when movement on this fault will recur or which of the mappel breaks will move next. However, the recency of the scarps suggest that some of them may well move in the future. Movement would not necessarily be confined to the mapped surface breaks, although experience else where in the world suggests that the lines of most recent ground breakage have the best chance for renewed future movement. Such movements may occur suddenly during major earthquakes, or they may result from nearly continuous expense without significant seignifity. continuous creep without significant seismicity.

The minimum age of the scarps plotted on the strip maps has been determined by tree ring counts of the oldest trees on the scarps as approximately 225 years. At many localities vegetation on the scarps is rooted in well-developed soil that may be considerably older than the age of the oldest trees. The maximum age of the scarps was determined as 1860+250 years B.P. by radiocarbon dating of organic material from a buried soil horizon that is displaced by the fault. This offset soil was sampled in a trench that was dug across the fault at locality 73APr12OA (radiocarbon sample number W293O) just east of the Little Susitna River. At this locality, the fault plane dips northward at an angle of 75 degrees and the well-defined scarp is 2.1 m (7 ft) high. In summary, then, the most recent breaks along the Castle Mountain fault are between 225 and 1700 years old and most probably originated through roughly 2.1 m vertical displacement or 2.3 m (7.4 ft) of dip-slip movement. The amount of horizontal offset related to this event is not known. The 7 meters apparent horizontal offset of a linear sand ridge that crosses the fault may result from a number of successive earthquake-related displacements, from slow tectonic creep between earthquakes, or from a combination of both.

EXPLANATORY NOTE

Surface geology and Holocene breaks along the Susitna segment of the Castle Mountain fault, Alaska

This strip map is one of a series of U. S. Geological Survey maps and reports that delineate and evaluate geologic hazards related to earthquakes in Alaska. It shows the location and characteristics of Holocene fault breaks along the trace of the Castle Mountain fault. Knowledge of the character and location of these breaks is important to scientists and engineers who study faulting and earthquakes and should be helpful to those concerned with land use in the rapidly developing Susitna Lowland. The lines on the strip map denote fault breaks along which displacements of the ground are interpreted to have occurred during the past several the strip was a report of the several that the second strength was a report of the several that the second strength was a report of the second strength was a seco

thousand years (late Holocene time). Map users should be aware that these lines are primarily guides for locating breaks on the ground and that they may not necessarily be located with the precision required for

The Castle Mountain fault is one of many long surface faults with linear traces in Alaska. The fault was first recognized by Martin and Katz (1912) along the south front of the Talkeetna Mountains in the upper Matanuska Valley area and was named by Barnes and Payne (1956) for the locality just north of Castle Mountain where the fault trace is beautifully exposed. Karlstrom (1964) first noted the recent scarp in the Susitna Lowland, which he interpreted as a normal fault in line with the Castle Mountain fault further east. The fault extends from the Copper River basin westward to southwestward along the front of the Talkeetna Mountains 1967: 1963:

and across at least part of the Susitna Lowland, a distance of roughly 200 km (St. Amand, 1957; Jones, 1963; Grantz, 1965, 1966; Kirschner and Lyon, 1973). The western extent of the zone of active faulting is not known. Available data are inadequate for determining whether the fault dies out, continues in a straight line west-southwestward an additional 250 km into the Lake Clark fault, or merges with the Bruin Bay system

of faults that extends southwestward for several hundred kilometers along the northwestern margin of the Cook

Inlet basin (see index map). Until continuity between the Castle Mountain and Lake Clark faults can be

demonstrated, we propose to restrict the term Castle Mountain fault to the segments in the Susitna Lowland

The Castle Mountain fault has been active over a span of millions of years, and it is marked by net

displacements across it that are measurable in kilometers or tens of kilometers. Probably the amount and sense of displacement across the fault varies along the fault's length and has changed with time during its long and complex history. In the Susitna Lowland and Talkeetna Mountains the Castle Mountain fault dips steeply northward at the surface or is vertical. In late Tertiary (mainly post-Oligocene) time the displacement has involved predominantly dip-slip reverse movement in which the north side is relatively upthrown.

Cenozoic vertical displacement ranges from a minimum of about 1/2 km in the subsurface of the Susitna Lowland (Kelley, 1963) to at least 1.2 km in the upper Matanuska Valley (Barnes and Payne, 1956). Several kilometers to perhaps a few tens of kilometers of latest Cretaceous to Oligocene dextral strike-slip is inferred by Grantz (1965, 1966) for the eastern end of the fault on the basis of juxtaposition of lithologically dissim-

ilar Cretaceous rocks together with the geometry and distribution of secondary faults and folds. Kirschner and Lyon (1973) cite the apparent dextral offsets of the Susitna River and Little Susitna River which imply possible active strike-slip movement on the fault. In both cases, however, the offsets appear to be more readily explained as diversion of the river courses by ridges of glacial moraine, rather than by tectonic faulting.

The fault breaks shown on the strip maps were located by study of 1:20,000 scale aerial photographs and

by aerial observation. All of them were traversed on the ground during June and July of 1973. Because the strip maps are based on the same photographs that were used in field mapping, plotted map locations of fault features are exceptionally precise. The mapped breaks are probably located to within 25 m (80 ft) of their actual positions with respect to the topographic or vegetation features shown on the strip map.

Surface features related to Holocene (post-glacial or approximately the last 5,500 years) movements on

nized by topographic anomalies or by contrasting vegetation that reflects varying depths to ground water or soil differences across the fault trace. The brief notes on the map describe the characteristics of the more

noteworthy features marking the position of the fault that have been examined in the field; comparable fea-

The Susitna Lowland is a glaciated lowland containing areas of ground moraine and stagnant ice topography, drumlin fields, eskers, and outwash plains (Wahrhaftig, 1965). Most of the lowland is less than 150 meters above sea level and has a local relief of 15 to 75 meters, mainly on topographically irregular glacial

The most common mappable features are southward-facing scarps of variable height that are modified by erosion. These generally have lines of trees on the better-drained upthrown side and muskeg on the downthrown side where the water table is at or very close to the surface. In some areas of exceptionally good drainage forest extends across the scarps that mark the fault traces, and in such cases the traces may not be detectable on airphotos. Although the scarps are commonly overgrown with muskeg, brush, or trees, steeper segments have sporadic vegetation-free patches. In such places, the soil layer appears to have sloughed off leaving the underlying unconsolidated deposits (generally gravel) exposed. In addition to the scarps, the fault trace is locally marked by low ridges or isolated small hills on the upthrown side. At one locality, a north-trending sand ridge of unknown age appears to be offset laterally across the fault trace suggesting a component of dextral horizontal displacement of roughly 7 meters. Features indicative of large-scale horizontal displacements such as offset streams, and markedly en echelon offsets or step-overs of the trace do not occur along the fault. The subtle en echelon offsets that locally step the trace to the left are in the correct sense for a component of dextral strike-slip displacement in five localities and sinistral in four localities.

Recently active fault breaks are recognized chiefly by relatively short-lived geomorphic features whose preservation is dependent on climate, which greatly influences vegetation and weathering, and on wind, stream, and slope processes, which may obliterate the fault breaks through erosion or burial. The fault breaks shown on the strip map are not known to have been active during historic time and may not have been active during the last millenium. Although the fault lies within the broad zone affected by regional warping and horizontal movements during the 1964 blacks earthquake, there is no evidence that it slipped during that seismic event

movements during the 1964 Alaska earthquake, there is no evidence that it slipped during that seismic event (Plafker, 1969). Fault breaks are preserved mainly in flat areas of especially slow sedimentation and erosion, but they have been obliterated to the east of the map area in the active flood plain of the Little Susitna and to the west of it in the flood plain of the Susitna River. Fault breaks could not be identified in the heavily vegetated area of hummocky end moraine and pitted outwash west of the Little Susitna River (map units Qem and One) where deversions may have erased the evidence of recent

moraines. Dune sand ridges are locally developed on the alluvial and glacial deposits of the lowland. The water table is commonly within a few meters of the surface, and the ground is seasonally frozen near the surface. Permafrost is present only in a few bogs.

tures, however, are developed to some degree along the entire length of the fault.

Orthophoto mosaic prepared by

U.S.G.S. September 1973 from photography flown 29 June 1974

some engineering or land utilization purposes.

FIELD RECOGNITION AND CLASSIFICATION OF HOLOCENE FAULTING

CASTLE MOUNTAIN FAULT

Qpo) where downslope movement of soil and unconsolidated materials may have erased the evidence of recent faulting.

EXPLANATION OF MAP TERMS Scarp; sharp, fresh break im topography; bank, less sharp, rounded break in topography, may indicate greater age or increased erosion at that point; slope break, linear change in gradient across a slope probably as a result of displacement on a fault; vegetation alignment, linear trend with trees on upthrown dry side of fault and wet muskeg on downthrown side; vegetation lineament, subtile, linear vegetation change generally in areas of wet muskeg.

Contact Castle Mountain Fault Solid line, topographic evidence of recent movement suggested by aligned scarps, banks, and offset stabilized sand dunes; <u>long dash</u> where position of trace less certain due to erosion of fault features; <u>short dashed line</u>, less obvious topographic or geologic evidence of recent movement, but probably a fault trace; <u>quemied</u> where tectonic origin uncertain; <u>dotted line</u>, possible location of fault across alluvium by projection, but <u>lacking any surface expression</u>. <u>Hachures</u> are on relative downthrown side of scarps; <u>pairs of arrows</u> indicate sense of relative horizontal displacement, where <u>known</u>; <u>short arrow</u> and numeral indicate direction and amount of dip on fault plane, where known.

EXPLANATION OF MAP SYMBOLS

ANNOTATED BIBLIOGRAPHY

Applied name Castle Mountain fault to the fault mapped by Martin and Katz (1912) along south side of Talkeetna Mountains. Suggested on the order of 4,000 feet vertical displacement on fault north of Wishbone Hill and describe a crush zone of mylonitized rocks along fault zone.

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Suggests large late Cenozoic dextral strike-slip displacement of Castle Mountain fault in Susitna Lowland on basis of offset stream drainages and the bent axial traces of some subsurface folds. Believes that the dextral component of movement is dissipated in several splays in the western Susitna Lowland in a manner analogous to that proposed by Grantz (1966) for the eastern end of the fault.

stratified sediments deposited in present stream flood plains SWAMP DEPOSITS--Silt, typically grass covered flat areas near lakes and streams; poorly drained TERRACE DEPOSITS--Gravel, sand, and silt, poorly stratified, generally well-drained and tree-covered

YOUNG OUTWASH DEPOSITS--Sand, silt, and gravel, crudely stratified, moderately-well-drained, tree-covered HUMMOCKY SWAMP DEPOSITS -- Chiefly silt with wet muskeg, shrubs, and stunted spruce, contains hummocks of dry sand (stabilized

dunes) with mature mixed forest GLACIOFLUVIAL CHANNEL DEPOSITS--Silt, chiefly in abandoned channels, locally contain streams; grass covered, swampy OLD OUTWASH DEPOSITS--Gravel, sand, and silt, poorly stratified, in front of Naptowne end moraine

I Mile

I Kilometre

PITTED OUTWASH DEPOSIT--Gravel, sand, and silt; contains numerous Qpo lice-contact features and depressions formed by melting ice blocks; generally well-drained and forested END MORAINE--Unsorted glacial till (mud, silt, sand, and cobbles), forms well-forested irregular hills and ridges; part of the Elmendorf moraine, marks maximum advance of Naptowne Glaciation RECESSIONAL MORAINE--Unsorted glacial till marking major still-stand of Naptowne Glaciation

GROUND MORAINE--Unsorted glacial till in low rounded knobs with numerous kettle depressions; poorly to well-drained GLACIAL DEPOSITS UNDIVIDED--Pre-Wisconsin drift west of Susitna LOESS DEPOSITS (not mapped)--a few inches to several feet thick mantles entire area

INDEX MAP SHOWING LOCATION OF CASTLE MTM. FAULT

SUSTINA SEGMENT TALKETTNA SEGMENT CASTLE MOUNTAIN FAULT CASTLE MOUNTAIN FAULT MATANUSKA NALLEY Base map from Army Map Service, Corps of Engineers 50 MILES 100 KM MAP SHOWING LOCATION OF STRIP MAP SEGMENTS AND MAJOR PHYSIOGRAPHIC PROVINCES

SURFACE GEOLOGY AND HOLOCENE BREAKS ALONG THE SUSITNA SEGMENT OF THE CASTLE MOUNTAIN FAULT, ALASKA

Robert L. Detterman, George Plafker, Travis Hudson, Russell G. Tysdal and Nazario Pavoni Reprinted 1979 Interior--Geological Survey, Reston, Va. For sale by Branch of Distribution, U.S. Geological Survey Box 25286, Federal Center, Denver, CO 80225





